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Towards a Cognitive Architecture for Mental Model Sharing: Redefining Knowledge-Based Systems

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What are you thinking?

What are the reasons that make “twitter” (*What are you doing?*), social networking and experiential sharing so successful and fun? Sharing interests and experiences as well as personal thoughts are becoming a natural part of Internet. Digital communication is much more than e-mail!

Remember, the major bottleneck in the expert system approach was knowledge acquisition. Powerful “expert systems shells” were supposed to solve the communication problem. It did not. A part of the problem is the nature of human cognition and expertise, in particular. The difference between *explicit* and *tacit knowledge* is well-known (c.f. Brown, Collins, & Duguid, 1989), where *tacit* often means that the *mental models* of expertise are not easy to verbalize.

This paper reports on an ongoing research effort to explore the issues especially addressed in the Eureka project (Bobrow & Whalen, 2002): *Eureka’s effectiveness is not based on the sophistication of its technology but on its insights about how and why people share knowledge.*

Workflow Fluency and Situated Cognition

The relation between working, learning, and knowledge-creation has been discussed and analyzed in several seminal works. *Constructive learning* emphasizes the need for experience, cognitive imitation, and modeling (Brown & Duguid, 1991; Nonaka & Takeuchi, 1995).

In order to improve fluency in the workflow, we need an environment in which the novice is exposed to expertise and able to imitate. Tacit knowledge might be difficult to verbalize – maybe impossible – but *visible in behavior*.

For example, operating a process plant means to monitor and supervise the flow in order to minimize downtime. Figure 1 shows the project’s research domain. At the outset

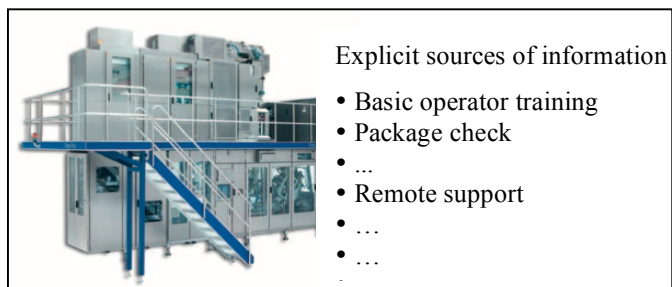


Figure 1: A3/Flex, packaging platform from Tetra Pak

there are a few explicit sources of information found in manuals and training courses in which new users are introduced to “best practice”.

As experience increases the factual knowledge and the basic skills are developed into specialized, implicit sources of knowledge. How is successful “know-how” – *workflow fluency* - communicated within the operating community?

According to the SECI model of Nonaka and Takeuchi (1995) two most important processes are *socialization* (S) and *externalization* (E). S is the process whereby tacit knowledge is situated, explored, and maintained in social interactions, whereas E is transforming tacit (partly implicit) knowledge into an external format.



Figure 2: Knowledge sources for mental models

Figure 2 illustrates a number of knowledge sources that can be bundled in different ways depending on operator, team, machine, or country! Together they are the content – *mental models* – of the knowledge-sharing process.

Community Climate: Affordance & Constraint

The point here is simple, but complex in its detail: How can we design information architecture in which sharing knowledge – *personal mental models* – is rewarding and fun? The “know-how” for operating A3/Flex is distributed. An approach is to develop a community network (as in Eureka or Twitter!) in which the platform is the in focus for all stakeholders. The workflow is guided by constraints and affordances given by the users in the community workflow.

Acknowledgement

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